

CLAIMS

1. A biological sample discrimination apparatus comprising:

a plate on which a channel pattern is formed, said channel pattern comprising a first channel into which a buffer agent is injected, and a second channel having, in a portion thereof, a quantification part that has a portion common to the first channel, and holds a predetermined amount of a biological sample, said biological sample being injected into the channel including the quantification part;

a filling unit for filling the buffer agent into the first channel of the plate while filling the biological sample into the second channel including the quantification part, and thereafter, making a predetermined amount of the biological sample remain in the quantification part of the second channel to add the predetermined amount of the biological sample to the buffer agent; and

a discrimination unit for making the predetermined amount of the biological sample that is held in the quantification part migrate in the buffer agent to discriminate the biological sample that migrates in the buffer agent.

2. A biological sample discrimination apparatus as defined in Claim 1 wherein

said plate has a buffer agent injection part connected to the

first channel, a sample injection part connected to the second channel, and an air hole connected to the sample injection part in the second channel, and

said filling unit,

rotates the plate in which the buffer agent is injected into the buffer agent injection part and the sample is injected into the sample injection part, thereby to make the buffer agent stored in the buffer agent injection part flow into the first channel by a centrifugal force, and simultaneously, make the biological sample stored in the sample injection part flow up to a first flow position that does not reach the quantification part in the second channel,

pressurizes the sample injection part to make the biological sample in the second channel flow from the first flow position up to a second flow position including the quantification part in the second channel, and thereafter,

rotates the plate to separate the biological sample in the second channel so that a predetermined amount of the biological sample remains in the quantification part of the second channel.

3. A biological sample discrimination apparatus as defined in Claim 1 wherein

said plate has a buffer agent injection part connected to the first channel, a sample injection part connected to the second

channel, and an air hole connected to the sample injection part in the second channel, and

said filling unit

rotates the plate in which the buffer agent is injected into the buffer agent injection part and the sample is injected into the sample injection part, thereby to make the buffer agent stored in the buffer agent injection part flow into the first channel by a centrifugal force, and simultaneously, make the biological sample stored in the sample injection part flow up to a first flow position that does not reach the quantification part in the second channel,

pressurizes the sample injection part to make the biological sample in the second channel flow from the first flow position up to a second flow position including the quantification part in the second channel, and thereafter,

performs aspiration from the air hole to separate the biological sample in the second channel so that a predetermined amount of the biological sample remains in the quantification part of the second channel.

4. A biological sample discrimination apparatus as defined in Claim 2 or 3 wherein said filling unit includes

a motor for rotating the plate at a high speed, and

a pressure control part for pressurizing or aspirating the second channel.

5. A biological sample discrimination apparatus as defined in Claim 2 or 3 wherein

said filling unit is disposed at a lower part of the biological sample discrimination apparatus while said discrimination unit is disposed at an upper part of the apparatus, and

said apparatus further including an elevation stage for vertically driving the plate between the filling unit and the discrimination unit.

6. A biological sample discrimination apparatus as defined in Claim 5 wherein

said discrimination unit is hung, via a spring, from a ceiling board which is provided in an upper portion of the apparatus.

7. A biological sample discrimination apparatus as defined in Claim 6 wherein

a pressure control unit for pressurizing or aspirating the second channel is hung from the ceiling board via a spring.

8. A biological sample discrimination apparatus as defined in Claim 2 or 3 wherein

said discrimination unit includes a heater for measuring a

temperature of the first channel with a thermistor, and controlling the first channel to a predetermined temperature in accordance with a result of the measurement.

9. A biological sample discrimination apparatus as defined in Claim 8 wherein

said discrimination unit includes, instead of the heater and the thermistor, a heat contact pin and a thermistor contact pin for applying a voltage to a heater and a thermistor which are provided on the plate.

10. A biological sample discrimination apparatus as defined in Claim 8 wherein

said heater is disposed on the first channel, and said thermistor is disposed at a position that is separated from the heater by a distance between the first channel and the heater.

11. A biological sample discrimination apparatus as defined in Claim 8 wherein

said thermistor is disposed on the first channel, and said heater is disposed at a position that is separated from the thermistor by a distance between the first channel and the thermistor.

12. A biological sample discrimination apparatus as defined

Claim 2 or 3 wherein

said discrimination unit includes a fitting pint to be inserted into a fitting pin hole provided on the plate, and a low-speed rotation motor for rotating the discrimination unit at a low speed, and

after the plate is fitted and fixed to the discrimination unit with the fitting pin, the plate as well as the discrimination unit are rotated at a low speed by the low-speed rotation motor, and the biological sample that migrates in the buffer agent is discriminated during the low-speed rotation of the plate.

13. A biological sample discrimination apparatus as defined in Claim 12 wherein

said discrimination unit includes a positioning mark detection sensor for detecting a positioning mark that is provided on the plate, and

said plate is rotated at a low speed by the low-speed rotation motor, and the fitting pin hole on the plate is detected by the positioning mark detection sensor to determine the position of the plate, and thereafter, the fitting pin is inserted in the fitting pin hole.

14. A biological sample discrimination apparatus as defined in Claim 2 or 3 wherein

said discrimination unit is provided with a positive electrode and a negative electrode, and

after the filling unit separates the biological sample in the second channel so that a predetermined amount of the biological sample remains in the quantification part of the second channel, the positive electrode and the negative electrode are inserted in the first channel, and a voltage is applied between the positive electrode and the negative electrode to make the predetermined amount of the biological sample stored in the quantification part migrate by electrophoresis in the buffer agent, whereby the biological sample that migrates in the buffer agent is discriminated.

15. A biological sample discrimination apparatus as defined in Claim 14 wherein

said plate is provided with a cleaning region for cleaning the positive electrode and the negative electrode, and

after the filling unit separates the biological sample in the second channel so that a predetermined amount of the biological sample remains in the quantification part of the second channel, the positive electrode and the negative electrode are cleaned in the cleaning region, and then the positive electrode and the negative electrode are inserted into the first channel.

16. A biological sample discrimination apparatus as defined in

Claim 14 wherein

said discrimination unit includes, instead of the positive electrode and the negative electrode, two electrode contact pins for applying a voltage to a positive electrode and a negative electrode which are provided on the plate.

17. A biological sample discrimination apparatus as defined in Claim 14 wherein

said biological sample is a DNA sample, and

said buffer agent contains a DNA conjugate for separation comprising a linear polymer to which a base sequence that is hydrogen-bondable to a target DNA as a detection target included in the DNA sample is bonded, a DNA bonding control agent, and a pH buffer agent.

18. A biological sample discrimination apparatus as defined in Claim 1 further including:

a cooling fan for cooling the increased temperature in the apparatus, and

a light cutoff part for cutting off light incident from the outside of the apparatus, which is disposed on an air intake port of the cooling fan.

19. A biological sample discrimination apparatus as defined in Claim 18 wherein

said light cutoff part comprises a porous film.

20. A biological sample discrimination apparatus as defined in Claim 18 wherein

said light cutoff part comprises an L-shaped or crank-shaped baffle plate.

21. A biological sample discrimination apparatus as defined in Claim 2 or 3 wherein

said discrimination unit includes an optical detector for detecting a fluorescence or an absorbance of the buffer agent that is filled in the first channel, and

discriminates the biological sample that migrates in the buffer agent, on the basis of a result of the detection by the optical detection unit.

22. A biological sample discrimination apparatus as defined in Claim 21 wherein

said optical detection unit is disposed on an elevation stage for vertically moving the plate, and

a height adjustment unit for measuring a distance between the plate and the elevation stage and performing adjustment so as to make the measurement result constant is disposed on the elevation stage.

23. A biological sample discrimination method for detecting a biological sample that migrates in a buffer agent to discriminate the biological sample, comprising:

using a plate on which a channel pattern is formed, said channel pattern including a first channel into which the buffer agent is injected, and a second channel having, in a portion thereof, a quantification part that has a portion common to the first channel, and holds a predetermined amount of a biological sample, said biological sample being injected into the channel including the quantification part;

filling the buffer agent in the first channel;

filling the biological sample in the second channel including the quantification part;

leaving a predetermined amount of the biological sample in the quantification part of the second channel, and adding the predetermined amount of the biological sample to the buffer agent; and

making the predetermined amount of the biological sample migrate in the buffer agent to discriminate the biological sample that migrates in the buffer agent.

24. A biological sample discrimination method as defined in Claim 23 comprising:

rotating, at a high speed, a plate on which a channel pattern is formed, said channel pattern including the first

channel into which the buffer agent is injected, the second channel including the quantification part into which the biological sample is injected, and an air hole that is connected to a sample injection part for injecting the biological sample, thereby to make the buffer agent flow into the first channel by a centrifugal force to fill the first channel, and simultaneously, make the biological sample flow up to a first flow position that does not reach the quantification part in the second channel;

pressurizing the sample injection part of the second channel to make the biological sample in the second channel flow from a first flow position to a second flow position including the quantification part in the second channel;

rotating the plate at a high speed to separate the biological sample in the second channel so that a predetermined amount of the biological sample remains in the quantification part of the second channel by a centrifugal force;

setting the first channel at a constant temperature; and

making the predetermined amount of the biological sample stored in the quantification part migrate in the buffer agent to discriminate the biological sample that migrates in the buffer agent.

25. A biological sample discrimination method as defined in Claim 23 comprising:

rotating, at a high speed, a plate on which a channel

pattern is formed, said channel pattern including the first channel into which the buffer agent is injected, the second channel including the quantification part into which the biological sample is injected, and an air hole that is connected to a sample injection part for injecting the biological sample, thereby to make the buffer agent flow into the first channel by a centrifugal force to fill the first channel, and simultaneously, make the biological sample flow up to a first flow position that does not reach the quantification part in the second channel;

pressurizing the sample injection part of the second channel to make the biological sample in the second channel flow from a first flow position to a second flow position including the quantification part in the second channel;

performing aspiration from the air hole of the second channel to separate the biological sample in the second channel so that a predetermined amount of the biological sample remains in the quantification part of the second channel;

setting the first channel at a constant temperature; and

making the predetermined amount of the biological sample stored in the quantification part migrate in the buffer agent to discriminate the biological sample that migrates in the buffer agent.

26. A plate for performing discrimination of a biological sample, having a channel pattern comprising:

a buffer agent injection part for injecting a buffer agent that reacts with the biological sample into the plate;

a first channel connected to the buffer agent injection part;

a sample injection part for injecting the biological sample into the plate; and

a second channel connected to the sample injection part; and

said second channel including, in a portion thereof, a quantification part for holding a predetermined amount of the biological sample to be supplied to the first channel, and the first channel and the second channel being connected through the quantification part.

27. A biological sample discrimination plate as defined in Claim 26 wherein

said first channel and said second channel contact parallel to each other via the quantification part.

28. A biological sample discrimination plate as defined in Claim 26 wherein

first and second electrode insertion parts into which positive and negative electrode parts or a positive electrode and a negative electrode are inserted are provided in the first channel.

29. A biological sample discrimination plate as defined in Claim

26 wherein

said buffer agent injection parts are provided at the both ends of the first channel, and an air hole connected to the sample injection part is provided in the second channel.

30. A biological sample discrimination plate as defined in Claim 26 wherein

after the buffer agent is injected into the buffer agent injection part and the biological sample is injected into the sample injection part;

in a first step, the buffer agent injected from the buffer agent injection part is filled in the first channel;

in a second step, the biological sample injected from the sample injection part is filled in the second channel including the quantification part;

in a third step, the biological sample in the second channel is separated to make a predetermined amount of the biological sample remain in the quantification part; and

in a fourth step, the remaining predetermined amount of the biological sample migrates in the buffer agent in the first channel.

31. A biological sample discrimination plate as defined in Claim 30 wherein

said first step is filling the buffer agent into the first

channel by pressurization, aspiration, or capillary phenomenon.

32. A biological sample discrimination plate as defined in Claim 30 wherein

said second step of filling the biological sample into the second channel including the quantification part by pressurization, aspiration, or capillary phenomenon.

33. A biological sample discrimination plate for detecting a biological sample that migrates in a buffer agent to discriminate the biological sample, said plate having a channel pattern comprising:

a first channel having a portion in which the buffer agent is injected, said first channel being filled with the buffer agent when the plate is rotated at a high speed; and

a second channel including, in a portion thereof, a quantification part that has a portion common to the first channel, and holds a predetermined amount of the biological sample, said biological sample being flowed up to a first flow position that does not reach the quantification part when the plate is rotated at a high speed, and said biological sample stored in the second channel being flowed from the first flow position to a second flow position including the quantification part when the plate is pressurized.

34. A biological sample discrimination plate as defined in Claim 33 wherein

first and second electrode insertion parts into which a negative electrode and a positive electrode are inserted are provided in a portion of the first channel.

35. A biological sample discrimination plate as defined in Claim 33 wherein

said first channel comprises a channel having a round shape comprising an inner circumference channel positioned on an inner circumference side of an arc-shaped channel that extends in a circumference direction of a circle the center of which corresponds to the center of the biological sample discrimination plate, an outer circumference channel positioned on an outer circumference side thereof, and a radiation channel that extends in a radiation direction from the center of the circle, said radiation channel connecting both ends of the inner circumference channel and the outer circumference channel;

said second channel comprises the arc-shaped channel positioned between the inner circumference channel and the outer circumference channel, and a U-shaped channel provided in a portion of the arc-shaped channel; and

said quantification part comprises a portion of the outer circumference channel, and a portion of the U-shaped channel in the second channel, which portions contact in parallel to each

other.

36. A biological sample discrimination plate as defined in Claim 35 wherein

said buffer agent injection part in which the buffer agent is injected, which is connected to the first channel, is positioned on the inner circumference side of the first channel.

37. A biological sample discrimination plate as defined in Claim 35 wherein

said sample injection part in which the biological sample is injected, which is connected to the second channel, is positioned on the inner circumference side of the second channel.

38. A biological sample discrimination plate as defined in Claim 34 wherein

said first and second electrode insertion parts are provided in a portion of the radiation channel of the first channel.

39. A biological sample discrimination plate as defined in Claim 35 wherein

a buffer agent injection part for injecting the buffer agent is provided approximately in the center of the inner circumference channel of the first channel.

40. A biological sample discrimination plate as defined in Claim 35 wherein

when the buffer agent is filled in the first channel, the buffer agent is filled in the outer circumference channel and the first and second electrode insertion parts, in the first channel.

41. A biological sample discrimination plate as defined in Claim 35 wherein

the arc-shaped channel in the inner circumference channel is positioned on an ellipse arc in which the channel slightly deviates to the outer circumference channel side from the circular arc.

42. A biological sample discrimination plate as defined in Claim 35 wherein

the channel width of the inner circumference channel is wider than the channel width of the outer circumference channel.

43. A biological sample discrimination plate as defined in Claim 35 wherein

said outer circumference channel has a channel length adjustment part for adjusting a difference between the length of a channel from the first electrode insertion part and the quantification part, and the length of a channel from the second electrode insertion part to the quantification part.

44. A biological sample discrimination plate as defined in Claim 35 wherein

a sample injection part for injecting the biological sample is provided at an end of the second channel, and a sample pool for holding the biological sample injected from the sample injection part when the biological sample is filled in the second channel is provided at the other end of the second channel.

45. A biological sample discrimination plate as defined in Claim 28 or 34 wherein

a heater for heating the first channel and a thermistor for measuring the temperature of the first channel are provided above the first channel, and

a positive electrode and a negative electrode are provided in the first and second electrode insertion parts, respectively.

46. A biological sample discrimination plate as defined in Claim 28 or 34 wherein

said first and second electrode insertion parts have air holes.

47. A biological sample discrimination plate as defined in Claim 44 wherein

said sample pool has an air hole.

48. A biological sample discrimination plate as defined in Claim 26 or 33 wherein

said biological sample is a DNA sample, and

said buffer agent contains a DNA conjugate for separation comprising a linear polymer to which a base sequence that is hydrogen-bondable to a target DNA as a detection target included in the DNA sample is bonded, a DNA bonding control agent, and a pH buffer agent.

49. A biological sample discrimination plate as defined in Claim 28 or 34 wherein

electrode insertion ports into which the positive electrode and the negative electrode are inserted are provided at the first and second electrode insertion parts, and

cover films are put on the electrode insertion parts.

50. A biological sample discrimination plate as defined in Claim 26 or 33 wherein

a plurality of the channel patterns are formed on said biological sample discrimination plate.

51. A biological sample discrimination plate as defined in Claim 28 or 34 wherein

a cleaning region for cleaning the positive electrode and the

negative electrode are provided on the biological sample discrimination plate, and

the positive electrode and the negative electrode are cleaned in the cleaning region, and thereafter, the positive electrode and the negative electrode are inserted in the first channel.

52. A biological sample discrimination plate as defined in Claim 28 or 34 wherein

said buffer agent injection parts are provided at both ends of the first channel, and said buffer agent injection parts are used also as the electrode parts or the electrode insertion parts.

53. A biological sample discrimination plate as defined in Claim 26 or 33 wherein

said first channel and said second channel are formed by grooves that are formed on the plate surface, and a film that covers the plate surface.

54. A biological sample discrimination plate as defined in Claim 26 or 33 wherein

said first channel and said second channel are formed on the same surface of the plate.

55. A biological sample discrimination plate as defined in Claim 26 or 33 wherein

said first channel and said second channel are formed on different surfaces of the plate.

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